

composition of said crystalline material by using values derived from the radiation scattering powers of said elements E_1 to E_n and the position and integrated intensity of said portion of said at least one diffraction peak.

36. (New) A method according to claim 35 wherein the or each or some of said diffraction peaks, or the or each or some of said portions of said diffracted energy, is at a quasi-forbidden angle of diffraction from said semiconductor material.

37. (New) A method according to claim 36 wherein the or each or some of said quasi-forbidden diffraction is at a (002) reflection.

38. (New) A method according to claim 36 wherein the or each or some of said quasi-forbidden diffraction is at a (006) reflection.

39. (New) A method according to claim 35 wherein the or each or some of said diffraction peaks or the or each or some of said portions of said diffracted energy is resultant from a (004) reflection.

40. (New) A method according to claim 35 comprising using a knowledge of the structure of said material and the possible elements present in said material to determine the chemical composition of said material.

41. (New) A method according to claim 35 wherein said crystalline semiconductor material is assumed to be comprised of only a finite number of known predetermined chemical elements and said processor has operational in its processing of the measured input data and stored element scattering power values only the scattering powers for the known predetermined assumed finite number of elements that are assumed to be present.

42. (New) A method according to claim 41 wherein said material is assumed to be comprised of four or less chemical elements.

43. (New) A method according to claim 35 comprising determining the composition of a layer of a material and making use either of (i) a knowledge of the thickness of said layer, or (ii) an assumption of the thickness of said layer being analyzed.

44. (New) A method according to claim 35 comprising determining the composition of a single layer of a material on a substrate of said material.

45. (New) A method according to claim 35 comprising either of (i) measuring the position of at least two diffraction peaks; (ii) measuring the position of at least two portions of the diffracted energy; and using a knowledge of their position to determine the relative amount of chemical elements in the chemical composition of said semiconductor material.

46. (New) A method according to claim 35 comprising either of (i) measuring the intensity of diffracted beams at at least two positions; (ii) or measuring the intensity of at least two portions of the diffracted energy; and using this knowledge to determine the chemical composition of said semiconductor material.

47. (New) A method according to claim 35 comprising measuring the intensity of either of (i) two diffraction peaks; (ii) two portions of the diffracted energy.

48. (New) A method according to claim 35 wherein said semiconductor material is a quaternary semiconductor material.

49. (New) A method according to claim 35 wherein said semiconductor material is a ternary semiconductor material.

50. (New) A method according to claim 48 further comprising either (i) measuring a parameter indicative of the lattice parameter of said quaternary semiconductor material; (ii) assuming a parameter indicative of the lattice parameter of said quaternary semiconductor material; and using this parameter and the intensity of either of (a) a diffraction peak, (b) the parameter indicative of the intensity; to provide, in a single diffraction measurement, an estimate of the composition of said material.

51. (New) A method according to claim 35 wherein said semiconductor material is a III-V semiconductor material.

52. (New) A method according to claim 35 wherein said composition of an at least partially strained semiconductor material is analyzed.

53. (New) A method according to claim 35 wherein said semiconductor material is a single crystal material.

54. (New) A method according to claim 35 wherein the percent of each chemical element of the chemical composition of said semiconductor material is analyzed with an error of 0.1% or below.

55. (New) A method according to claim 35 which comprising measuring a parameter indicative of the lattice parameter of said semiconductor material.

56. (New) A method according to claim 55 which is used to analyze the composition of a buried, non-surface, layer in the semiconductor material.

57. (New) A method according to claim 35 comprising comparing the detected composition of said semiconductor material to a reference composition to determine if the detected composition is either (i) equal to that composition; (ii) falls within a predetermined

range around the reference composition; and producing a first output if said measured composition falls within said range and a second output if said measured composition falls outside said range.

58. (New) A method according to claim 35 including integrating said portion of the diffracted radiation over a region of said diffraction peak centered upon a point of maximum intensity of said diffraction peak.

59. (New) A method of analyzing the composition of an at least partially strained material comprising irradiating said material with energy from an energy source which energy is diffracted from the material, detecting one or more portions of said diffracted energy, and analyzing said or each detected portion to obtain a parameter indicative of the position and/or intensity of the or each portion.

60. (New) Chemical composition analysis apparatus comprising a sample holder, a beam source, at least one detector, a controller, and a processor, said controller being adapted to control said beam source and detector in use so as to direct a beam of energy onto a sample held in said sample holder and detect diffracted energy at diffraction angles, said detector(s) being coupled to said processor to provide said processor in use with signals representative of the position of a diffraction peak and the intensity of said diffraction peak, and said processor being arranged such that in use it uses the detected signals, in combination with an assumption of what predetermined elements are present in said sample and the scattering power of atoms of

the elements that are assumed to be present, or a factor dependent upon the scattering power of the predetermined elements, to evaluate the relative amounts of the predetermined chemical elements in the chemical composition of said sample.

61. (New) Apparatus according to claim 60 having an element selection inputter adapted to enable a user to identify to said processor which chemical elements are to be assumed to be present in said sample to be analyzed, and therefore which chemical element scattering powers, or factor dependent upon the scattering powers, are to be used by said processor in determining the relative amounts of the chemical elements in the sample, said processor being adapted in use to operate with its processor on the measured input variables from said detector(s) and a subset of element scattering powers, or derived values, selected from a larger set of stored element scattering powers, or derived values, said subset being selectable by the operation of the element selection inputter.

62. (New) Apparatus according to claim 60 wherein said sample holder, beam source and detector(s) are pre-set at predetermined positions relative to each other at a relationship where for a sample of a known kind said or at least one detector is disposed so as to detect at a quasi-forbidden diffraction angle.

63. (New) Semiconductor wafer checking apparatus comprising apparatus according to claim 60.

64. (New) A data carrier carrying a program which when running on detection apparatus is adapted to enable said apparatus to perform a method of claim 35.

65. (New) Apparatus for the analysis of the composition of a semiconductor material being arranged to operate in use in accordance with the method of claim 35.

66. (New) A composition measurement system arranged to analyze the composition of a semiconductor material according Claim 35 and to compare this to a reference or output the results of the analysis.

67. (New) A method of manufacturing a semiconductor chip comprising manufacturing a semiconductor wafer, analyzing the composition of said wafer according to claim 35 to test if it passes or fails a composition analysis test, and performing fabrication operations on said wafer to produce the chip if the wafer has a composition within predetermined parameters, and rejecting the wafer for further processing or fabrication operations if it has a composition outside of said predetermined parameters, rejected wafers not being subject to at least one processing step that they would have received had they passed.

68. (New) A method according to claim 67 wherein wafers that pass said compositional analysis test and/or chips produced from such wafers are accompanied by data either confirming that they passed, or data giving details of their compositional analysis.

69. (New) A method of determining the relative amounts of different chemical elements in the chemical composition of a crystalline quaternary semiconductor material, the method comprising diffracting a beam of radiation off the crystalline material and measuring the angle of at least one diffraction peak and the intensity of diffracted radiation at said diffraction angle, and using a processor to determine the relative amounts of the elements in the chemical composition of said crystalline material by using values derived from the radiation scattering powers of the elements and the position and intensity of said at least one diffraction peak.

70. (New) A method of determining the relative amounts of different chemical elements E_1 to E_n in the chemical composition of a crystalline semiconductor material, the method comprising diffracting a beam of radiation off the crystalline material and measuring the angle of at least one diffraction peak and the intensity of a portion of the diffracted radiation integrated over a window centered on the maximum peak intensity of said at least one diffraction peak located at said diffraction angle, and using a processor to determine the relative amounts of the elements E_1 to E_n in the chemical composition of said crystalline material by using values derived from the radiation scattering powers of said elements E_1 to E_n and the position and integrated intensity of said window of said at least one diffraction peak.